Cores for concern: The difficulty of recording tephra fallout deposits in marine sediments

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Detailed knowledge of the past history of an active volcano is crucial for the prediction of the timing and frequency future eruptions, and identification of potentially at risk areas. Studies of subaerial volcanic stratigraphies are often incomplete, due to a lack of exposure, or burial and erosion from subsequent eruptions. However, as a large proportion of volcanic deposits are deposited in the sea, cores of marine sediment have the potential to provide a more complete stratigraphic record of tephra fallout deposits. Nevertheless, problems such as bioturbation and dispersal by currents persist in the preservation and subsequent detection of marine tephras. Consequently, cryptotephras, which are invisible to the naked eye, may be the only record of pyroclastic fallout in the marine record. Additionally, thin, reworked volcanic deposits transported by floods and landslides are often interpreted as primary tephra fallout deposits, leading to the construction of inaccurate records of volcanism. This work uses the volcanic island of Montserrat as a case study to test novel techniques developed to generate volcanic eruption records from marine sediment cores. We outline a set of time-efficient, non-destructive and high-spatial-resolution analyses (e.g. XRF core-scanning and magnetic susceptibility) that can be used to effectively detect potential cryptotephra horizons in marine sediment cores. Following these, sampling of these potential tephras horizons for microscope analysis should be employed to discriminate between primary and reworked volcanic deposits. Our method involves using specific criteria related to clast morphology, compositional maturity, sorting and sedimentological facies indicators to determine primary from reworked deposits. As a result of these procedures, more individual tephra fallout deposits have been recognised around Montserrat in our study, than previous marine tephrochronological studies in this region. We suggest that standard practice be employed when analysing marine sediment cores to determine both visible and cryptotephra layers and ascertain primary and secondary volcaniclastic deposits.